Non-Intrusive Inspection: An Introduction
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Internal Visual Inspection (IVI)

Positives

• Industry accepted practice
• Can inspect for a variety of degradation mechanisms without prior knowledge
• Can clean out deposits at the same time
• Can check on internal furniture

Negatives

• Requires shutdown
• Requires vessel cleaning
• Requires man-entry
• Additional NDT required for some mechanisms
• Not always quantitative
• Poor reporting can cause issues for repeatability
What is Non-Intrusive Inspection (NII)?

You cannot do “a bit of NII”

Definition:

*NII is a process in which*

- Inspection is aimed at replacement or deferment of internal visual inspection (IVI)
- Planning and evaluation is carried out to ensure the inspection meets a specific set of criteria.

*NII is not:*

- Any inspection that is performed without the need to open an equipment item.
- An ad-hoc inspection that makes some use of externally applied techniques.
# Non-Intrusive Inspection (NII)

## Positives
- Does not need shutdown
- External cleaning only
- Avoids man-entry
- Quantitative
- Reproducible
- Can detect additional issues IVI cannot

## Negatives
- Industry slow to accept
- NDT methods are often morphology specific
- No information on internal furniture
- Poor application of NII can result in poor integrity decisions

NII requires more upfront planning to ensure aim of inspection is met.
2018 update out soon
NII Process

NII Assessment and definition of requirements

\[ P(\theta_j | X) = \frac{P(X | \theta_j) P(\theta_j)}{P(X | \theta_j) P(\theta_j)} \]

Inspection

Evaluation of inspection and Analysis of results

Justification

Workscope meeting requirements
## NII Strategy

### Table 4-1 Inspection Type Definitions

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Degradation mechanism NOT expected to occur. Inspection is required to confirm there is no onset of the degradation mechanism.</td>
</tr>
<tr>
<td>B</td>
<td>Degradation mechanism expected, with low / medium progression. Location of degradation can be predicted. Not anticipated to impact on vessel integrity in the medium term (typically at least 2 outage periods). Inspection required to confirm CRA predictions.</td>
</tr>
<tr>
<td>C</td>
<td>Degradation expected with medium / high progression. Location of degradation can not be predicted. MAY impact on vessel integrity in the medium term (two-outage timeframe). Inspection required to confirm absence of flaws of critical size.</td>
</tr>
</tbody>
</table>
Inspection Techniques

- Corrosion Mapping
- Time of Flight Diffraction (TOFD)
- CHIME
- Multiskip
- Angled Shear Wave
- Pulsed Echo
- Phased Array
Inspection Deployment

Automated Scanners

Rope Access

Manual Scanners

Domed End Scanner

Flange Face Scanner

Nozzle Scanner

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Evaluation

- Did the coverage and locations meet the requirements?
- Did the techniques meet the requirements?
- Was the probability of detection achieved?
Examples

- **TEG Contactor**
  - Critical path for shutdown
  - IVI duration ~900 hours
  - NII reduced shutdown by 9 days

- **Gas plant saved £4m by rolling out NII to 40+ vessels**

- **IVI replaced by NII on onshore H₂S vessel saved £750K**

- **$7m production added by NII on onshore Gas Plant vessels for operator in Australia**
Key Success Factors for NII

• Detailed review of vessel history, process and risks.
• Appropriate coverage, inspection locations and techniques must be chosen.
• Inspection team must have:
  – In-depth understanding of equipment.
  – Ability to deal with vessel specific difficulties.
  – Ability to judge data quality as it is being collected.
  – Ability to identify anomalies and define suitable follow up work.
  – Good communication with site personnel.
  – In-depth understanding of the objectives of the NII.
  – Good communication with the integrity team.

Failure to recognise the significance of the above can lead to valueless data being collected and a high cost of follow up.